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interfere within said medium and cause cationic polymerization therein, [forming within said medium an interference pattern and] thereby forming a hologram within said medium.

Cancel claims 15-27 without prejudice or disclaimer.

REMARKS

The amendment on page 1 simply updates the status of the copending application originally referred to.

In response to the election requirement set forth in Paragraphs 15-19 of the Office Action, applicants hereby elect Group I, claims 1-14. This election is now made *without traverse*, and consequently the non-elected claims 15-27 have been cancelled without prejudice to applicants' right to file divisional and/or continuation applications directed to the subject matter of these claims. No change in the inventorship of this application is required by this election.

In response to Paragraph 20 of the Office Action, the last paragraph of claim 1 has been amended to specify that the passage of the reference beam and object beam into the medium causes the reference beam and object beam to interfere within the medium and cause cationic polymerization therein. It is believed that this rewording of claim 1 fully meets the 35 USC 112 rejection set forth in Paragraph 20, but if the Examiner feels that any further rewording of the claim is advisable, he is respectfully invited to telephone the undersigned in order to agree upon a final wording of this claim.

The 35 USC 102(b)/103 rejection of claims 1, 3 and 12-14 as unpatentable over JP 05-094014 is traversed. More specifically, this rejection is traversed on the grounds that this reference does not disclose a process in accordance with any of the present claims, all of which require a holographic exposure involving cationic polymerization. The following comments are all based upon the English-language abstract of the reference, since the undersigned cannot read Japanese and is not in possession of a translation of the reference.

The present claims all require that the holographic recording medium comprise an acid generator capable of producing an acid upon exposure to actinic

radiation, a difunctional epoxide monomer or oligomer and a polyfunctional epoxide monomer or oligomer, the difunctional and polyfunctional epoxide monomers or oligomers being capable of undergoing *cationic* polymerization initiated by the acid produced from the acid generator. The claims further require that the interference between the reference beam and the object beam within the medium cause cationic polymerization therein.

In contrast, the reference teaches a medium comprising a "*radical-polymerizing* [sic] ethylenically unsaturated" monomer or monomers, a minor proportion of a "*photo-radical* polymerization initiator" and an epoxy resin (emphases added). The epoxy resin appears to be a binder. Numerous specific monomers are listed; all are acrylates and most do not contain any epoxy groups, although epoxyacrylates can be used. Since there is no suggestion of cationic polymerization being employed (see below), the only reason for using an epoxyacrylate would appear to be compatibility with the epoxy resin binder. Similarly, numerous specific initiators are listed; most of these initiators, for example, benzoin alkyl ethers and peroxy acid esters, are "pure" free radical initiators which will not initiate cationic polymerization. However, the initiators used do include iodonium salts which (as the Examiner is no doubt aware) are capable of initiating both free radical and cationic polymerizations.

Thus, the reference essentially teaches a medium which uses a free radical initiator to cause polymerization of a free-radical polymerizable ethylenically unsaturated monomer. The abstract (see the last paragraph) specifically states that the composition undergoes efficient separation of the ethylene monomer and epoxy resin and can be fully cured by after-exposure with UV light or heat treatment; presumably such curing must be caused by cross-linking of the epoxy resin. The Examiner has not alleged that there is any specific composition disclosed containing both an epoxyacrylate and an iodonium salt, much less one containing a difunctional epoxyacrylate, a polyfunctional epoxyacrylate and an iodonium salt, which would appear to be the only material which could possibly result in a proper 35 USC 102 rejection of present claim 1.

With regard to the obviousness prong of the rejection, the undersigned attorney would point out that the case law is clear that the disclosure in a reference of lists of possible components in a composition does not anticipate or render obvious every possible combination of such components. More specifically, in the present case, just because it is possible, by careful selection from lists of possible monomers and polymerization initiators, to identify precisely those two monomers and one type of initiator which would produce a composition according to the present claim 1, does not render that claim obvious within the meaning of 35 USC 103 where (as here) the reference furnishes no guidance to effect this precise combination. Indeed, in this case the reference would teach the skilled person to avoid the combination. The skilled person would be expected to know that epoxy groups are susceptible to cationic polymerization, and that iodonium salts are capable of both free radical and cationic initiation. Accordingly, in attempting to carry out what is clearly intended to be a free radical initiated polymerization during the holographic exposure, the skilled person would be expected to avoid the combination of epoxy monomers and iodonium salts which would be susceptible to cationic rather than free radical polymerization. In simple terms, one does not expect an expert carrying out a free radical polymerization to deliberately choose components which would be likely to "mess up" the free radical polymerization by their susceptibility to cationic polymerization.

The 35 USC 103 rejection of claims 1-4 and 12-14, as unpatentable over Dhal et al., International Application Publication No. WO 97/1318 (hereinafter simply "Dhal" - in view of the PTO-892, applicant assumes this is the intended reference, although the Office Action itself consistently gives the number as 97/13118) in view of Ohe, U.S. Patent No. 5,689,345 and Keys et al. U.S. Patent No. 4,950,567, is traversed. More specifically, this rejection is traversed on the grounds that a skilled addressee would not combine these references in the manner suggested by the Examiner. In view of Paragraph 27 of the Office Action, it is noted that substitution of U.S. Patent No. 5,759,721 (issued on Application Serial No. 08/743,419) for International Application Publication No. WO 97/1318 would in no way affect the following arguments.

As discussed in the introductory part of the present application, holographic recording media which rely upon cationic polymerization without requiring free radical polymerization eliminate various problems of using free radical polymerized media. However, an important consideration in holographic recording media for digital data storage is the shrinkage of the medium during exposure. During image reconstruction (readout) of a single image, which comprises multiple gratings, from a digital data storage volume hologram comprising angle-multiplexed images is likely to result in lack of image fidelity and/or distortion, unless the shrinkage of the medium during the holographic exposure is reduced to extremely low levels. The applicants have discovered that holographic recording media based upon a mixture of difunctional and polyfunctional epoxide monomers (or oligomers) record holographically with reduced shrinkage, rendering these media especially suitable for use in digital data storage applications. These recording media also have lower threshold exposure energy requirements, thus allowing increased writing speed in data storage applications.

Applicants readily concede that Dhal describes a process which is generally similar to that of the present invention except that it does not use a mixture of difunctional and polyfunctional epoxide monomers, and that Dhal describes compositions using the difunctional monomer of present claim 4. Applicants further concede that polyfunctional epoxide monomers are known, and are known to be capable of cationic polymerization; see, for example, U.S. Patent No. 5,037,861 (noted at page 7, line 7 of this application), column 1, lines 26-38 and column 3, lines 24-27, which describe polyfunctional epoxide monomers of Formula (II) on page 7 of this application, and their cationic polymerization. (The undersigned attorney assumes that Ohe is cited only to show that polyfunctional epoxide monomers are known, and are known to be capable of cationic polymerization.) However, there is nothing in the prior art to teach the skilled person that using a mixture of difunctional and polyfunctional epoxide monomers will provide a medium with the minimal shrinkage required for good digital data storage holographic performance.

With respect, Keys in no way teaches that using a mixture of difunctional and polyfunctional epoxide monomers will provide a medium with low

shrinkage. Attorney for applicants assumes that the last complete paragraph on page 4 of the Office Action is intended to refer to column 6, lines 17-45 of Keys. In so far as relevant to the present application, Keys describes a recording medium comprising a polymeric binder, an *ethylenically-unsaturated* [i.e., free-radical polymerizable] liquid monomer, a plasticizer and a photoinitiator. The photoinitiator is explicitly stated to be one which directly furnishes free radicals which activated by actinic radiation (see column 7, lines 8-10 of Keys), as indeed the photoinitiator must be to polymerize the ethylenically-unsaturated monomers used, which are capable of free radical but not cationic polymerization. The aforementioned passage at column 6, lines 17-45 of Keys states that where cross-linking is desirable, for example during thermal enhancement or curing, up to about 5 weight percent of at least one multifunctional monomer *containing two or more terminal ethylenically unsaturated groups* typically is incorporated into the photopolymerizable layer (emphasis added). This is not surprising, since the use of tri- or higher functional unsaturated monomers to rigidify polymers is well known in polymer technology, as the Examiner is no doubt aware. However, it has nothing to do with the problem facing the present inventors.

Firstly, Keys recommends the use of di- or polyfunctional ethylenically-unsaturated monomers to rigidify a polymer formed by free radical polymerization of ethylenically-unsaturated monomers. The Examiner has not shown that this rigidifying effect can be extrapolated from polymers formed from ethylenically-unsaturated monomers to polymers formed by cationic polymerization of epoxide monomers.

Secondly and more importantly, the Examiner has not explained why anyone would be concerned about rigidifying the exposed Dhal composition. The Dhal composition is intended for use in digital data storage holograms, and in this application the physical properties of the recording medium are of relatively little importance, provided only that the hologram itself is stable; the recording medium is typically carried on a carrier (for example, the glass slides used in the experimental apparatus of the Example in Dhal) which provides mechanical support to the hologram.

Finally, Keys is of course completely irrelevant to the actual problem facing the inventors, which was to produce a holographic recording medium with reduced shrinkage. There is nothing in the references of record to suggest any correlation between rigidifying and reducing shrinkage, and attorney for applicants is not aware of any such correlation. Moreover, even if it could be shown that the rigidification effected by use of multifunctional monomers in Keys was associated with reduction of shrinkage, one could not extrapolate from the Keys to the Dhal compositions, since the two polymerizations are of completely different types. The free radical polymerization used in Keys essentially converts a plurality of vinyl groups containing sp^2 carbon atoms to a saturated polymethylene chain, whereas the Dhal cationic polymerization converts saturated epoxide rings to polymethylene chains. It will readily be apparent that the change in molecular volumes, and hence the shrinkage of the medium involved, will be very different in the two cases.

The 35 USC 103 rejections set out in Paragraphs 25 and 26 of the Office Action are traversed for the same reasons as set forth above with reference to Paragraph 24.

For all the foregoing reasons, the 35 USC 102 and 103 rejections are unjustified and should be withdrawn.

Reconsideration and allowance of all claims remaining in this application is requested.

Respectfully submitted

David J. Cole

David J. Cole
Registration No. 29629

Polaroid Corporation
Law and Patent Division
784 Memorial Drive
Cambridge MA 02139

Telephone (781) 386-6422

Facsimile (781) 386-6435

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I hereby certify that this paper, dated September 9, 1998, is being deposited with the United States Postal Service as first class mail in an envelope addressed to Assistant Commissioner for Patents, Washington DC 20231, on ***September 9, 1998***.

David J. Cole

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